

## Book Reviews

### Life-Cycle Impact Assessment: Striving towards Best Practice

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This book builds on the results of the second SETAC Europe Working Group on Life-Cycle Impact Assessment (LCIA); the group was active in the period 1998 to 2000, with about 50 participants from 15 countries involved. It is the result of the concerted action of 15 editors, 27 major contributors including the editors, and 23 additional contributors. The list of editors and contributors represents the 'star team' of Life-Cycle Impact Assessment researchers. The collection strives to make the first steps towards the identification of best available practice in LCIA, which is a tremendous challenge.

SETAC working groups aim at consensus building. Hence, there are clear signs of an intense consensus building process in the background of this work. Conclusions and recommendations are well balanced. The title 'Striving towards Best Practice' reflects the background, aim and scope of this book which can be seen as a 'hand-book' in respect to the potentials and possibilities in this field.

The Goal and Scope section is a critical part of any LCA study report. This is also found in the Foreword of this book which states that the real establishment of best practice largely remained outside the scope of the SETAC working group and hence outside the scope of this book; however, critical issues were discussed, some recommendations were made, etc. The book builds on the ISO 14042 standard document and provides a further elaborated platform for the future work in the UNEP-SETAC Life-Cycle Initiative programme. This is very clear, but what remains unclear is the answer to the key question, 'Best practice for what or to whom?' which is not discussed. However, maybe the answer can be found in the second last sentence of the Foreword which reads: "....in order to continue to stimulate bottom-up scientific input." Most parts of this book are written by researchers for researchers. It is supply-oriented rather than demand-oriented.

The work is divided into eight chapters, each one written by a separate team but in a uniform format. The contents of the chapters are aligned with the focuses of the various individual task forces within the SETAC working group. Thus, most space is allocated to critical issues in LCIA such as assessment of resources and land use, fate and exposure assessment of toxic chemicals, indicators for human toxicity and ecotoxicity, etc. The traditional impact categories, climate change, stratospheric ozone depletion, photooxidant formation, acidification, and eutrophication, are discussed in 32 of the total 225 pages.

Chapter 1, the introduction, is very well written. It is LCIA in a nutshell and provides a well-balanced discussion on key issues such as midpoint or endpoint indicators as well as temporal and spatial

differentiation. Although the application dependency of the appropriate level of sophistication is not treated in detail, it is at least clearly stated here. However, this important aspect of LCIA is not further discussed in the following chapters which focus on a 'bottom-up scientific input' providing a platform for the further development of appropriate impact assessment methods.

The authors of Chapter 2 on impact assessment of resources and land use make clear that the state-of-the-art concerning these impact categories does not allow any choice of the Best Practice. The lack of a common framework and agreement on a conceptual level calls for a discussion on principles, definitions, distinctions, and objectives. The chapter provides a comprehensive and in-depth discussion on these issues mainly based on published methods, and proposals for a framework are made. This chapter is most useful for anyone interested in impact assessment of resources and land use. The lack of reasonably agreed approaches for the assessment of resources and land use has always been one of the weak parts of LCA. The authors conclude that proposed methods vary to an extent that makes them hardly comparable due to a lack of agreed principles. It is possible that the proposals made in the chapter may help to harmonise future approaches, but the lack of a common ground, especially concerning resource use, goes beyond the LCA community. The main question, whether it is possible at all to find a common platform for the concept of resources, is still open. The concept of resources is perhaps an entirely value-based one which should be left at the inventory level or handled in a weighting exercise. A resource, and consequently resource depletion, means different things; materials, e.g. are resources of key interest to some people while others may look on the functions provided by materials.

The traditional impact categories, climate change, stratospheric ozone depletion, photooxidant formation, acidification, and eutrophication, are discussed in Chapter 3 where the reader can find a full state-of-the-art report on these mid-point indicators. They represent the most matured part of LCIA. Thus, the authors are able to make a clear distinction between recommendations to practitioners and recommendations to researchers. Application dependencies are, to some extent, included in the discussion. Recommendations to practitioners are in this case proposals for best practice. They are developed in a balanced manner, and most LCA experts will probably agree to them. However, there are preferences made for various levels of spatial differentiation without considering applications of pure technology assessment, where this may not be the proper choice, for example in early product design and environmental product declarations. Global mean values may of course handle that problem. Most LCA experts may agree to the key message that all

indicators along the cause-effect chain should at least refer to the same scientific platform, regardless of their level of sophistication. The user survey from the LCM part of the UNEP/SETAC Life Cycle Initiative clearly indicates a preference for mid-point indicators as those discussed in Chapter 3.

The next three chapters deal with toxicity starting with Chapter 4 on fate and exposure assessment, followed by Chapter 5 on human toxicity, and Chapter 6 on ecotoxicity. Together, these chapters provide a well-written discussion on risk assessment at various levels of sophistication. They deal with options and limitations of the classic problem of data availability and uncertainties. The reader gets a full state-of-the-art report that should be of interest to a larger audience than just the LCA community. The authors propose step-wise procedures and use of several approaches and conclude that it is still far too early to propose a Best Practice. No one will disagree to this conclusion. One may ask what should be done inside LCIA, given the apparent difficulties to come up with a workable approach for the assessment of toxicity in LCA. For example, the option to restrict LCA to screening, and the identification of candidates for further assessment using other tools are not discussed. These questions were found to be outside the scope of the SETAC workgroup, and thus outside the scope of this book. However, they still need to be addressed.

Normalisation, grouping and weighting are discussed in Chapter 7. Special emphasis is put on weighting. The authors state "It is significant that the last phase of an LCA is interpretation, in which conclusions are drawn and recommendations are made (ISO 1997). The results from the grouping and/or the weighting are thus not necessarily the final conclusions drawn from the overall LCA study, not the only factors considered in a decision." I think that the authors should better have replaced 'not necessarily' with 'never'.

This chapter includes a comprehensive overview of weighting methods and principles. The authors propose a very interesting and useful system of criteria for the evaluation of weighting methods. It is interesting in respect to the understanding of weighting since it provides a structured way to discuss the characteristics of weighting methods. It is a real contribution to the field, which should be applauded since the conclusions seem to be the same as always, namely: "There is no single weighting method that fulfils all relevant criteria", and a statement that distance-to-target methods are no weighting methods.

Chapter 8 discusses the conceptual structure of Life-Cycle Impact Assessment. It is based on a free discussion held in the SETAC working group. Although it claims to deal with terminology, it discusses concepts rather than terms, especially in respect to the so-called AoPs (Areas of Protection, see also the Online-Forum 'Global LCA Village' at <http://www.scientificjournals.com/sj/globalcavillage/welcome.htm>). However, it is a discussion inside the scientific field of LCIA. The application dependencies, the linkage to interpretation and the positioning of LCA, which obviously concern LCIA, are still open questions left to the further work in the UNEP-SETAC Life-Cycle Initiative.

For the book reviewer, it is always a good feeling to conclude with the statement that the conclusions are balanced and supported by the study. This is indeed true in this case. The book is not just a contribution to further development of LCIA. The detailed discussions on various methods and approaches may well serve as a useful 'handbook' on Life-Cycle Impact Assessment for anyone interested in a deeper understanding of the science behind this part of LCA methodology.

<http://www.scientificjournals.com/lca/>

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